

**Before the  
Federal Communications Commission  
Washington, D.C. 20554**

In the Matter of	)	
	)	
Amendment of the Commission's Rules to	)	
Establish a Next-Generation Air-Ground	)	RM-11640
Communications Service on a Secondary	)	
Licensed Basis in the 14.0 to 14.5 GHz Band	)	

**COMMENTS OF ALCATEL-LUCENT**

Alcatel-Lucent submits these comments in response to the above-captioned Petition for Rulemaking (the "Petition") filed by Qualcomm Incorporated ("Qualcomm") to establish a next-generation air-to-ground terrestrial-based communications service in the 14.0 to 14.5 GHz band. Alcatel-Lucent supports the opening of a rulemaking proceeding, but urges the Commission to conduct a comprehensive proceeding that not only considers Qualcomm's proposal, but also seeks comment on alternative frequency bands and other technical characteristics beyond those proposed in the Petition.

**I. INTRODUCTION**

Alcatel-Lucent is the trusted transformation partner of service providers, enterprises, and strategic industries worldwide, providing solutions to deliver voice, data and video communications services to end-users. A leader in fixed, mobile and converged broadband networking, IP and optics technologies, applications and services, Alcatel-Lucent leverages the unrivaled technical and scientific expertise of Bell Labs, a leading innovator in the communications industry. The following products represent some of Alcatel-Lucent's technological breakthroughs since 2010, alone:

- lightRadio™ – a groundbreaking antenna, capable of 2G, 3G, and 4G, small enough to fit in your hand, that promises to radically streamline and simplify mobile networks;
- 100G optical transmission – 100 Gigabit per second optical transmission and IP routing;
- DSL Phantom Mode – boosts the transmission speeds of copper DSL by 50%; and
- FP3 Processor – the world's first 400G network processor, which unlocks value for the next generation of online applications, entertainment and communications, while cutting power consumption by up to 50%.

In the area of air-to-ground communications, Alcatel-Lucent's Bell Labs prides itself on having shipped the first air-to-ground communications radios to the U.S. Army Signal Corps in 1917. (This equipment is on display in the Alcatel-Lucent North American Headquarters in Murray Hill, NJ.) Since that time, Bell Labs has continued to pursue air-to-ground communications opportunities both domestic and international. Alcatel-Lucent is currently spearheading a trial of air-to-ground service in Europe and is active in deliberations by the CEPT organization's DA2GC-B4P [Direct Air-to-Ground Communication – Broadband for Plans] working group. Alcatel-Lucent is well-positioned to operate an air-to-ground system with an LTE platform, modified to accommodate the higher Doppler frequency and timing shifts in the aeronautical channel.

With operations in more than 130 countries and the most experienced global services organization in the industry, Alcatel-Lucent is a local partner with a global reach. Alcatel-Lucent employs over 16,000 in the U.S., home to Bell Labs' global headquarters. Alcatel-Lucent's presence in the United States is central to its position as a world leader in emerging telecommunications technologies.

## II. THERE IS A NEED FOR ADDITIONAL SPECTRUM FOR AIR-TO-GROUND SERVICES

Alcatel-Lucent commends Qualcomm for providing its thoughtful and detailed proposal for a new communications service to provide broadband connectivity to aircraft. Alcatel-Lucent agrees that there is a need for additional spectrum for the existing air-to-ground service. Indeed, Aircell's 3 MHz of spectrum is likely to be insufficient to support the rapidly growing demand for wireless data services on aircraft. The flying public is a particularly communicative population of "road warriors" and generally people who are engaged in time-critical coordination of travel plans and business arrangements. Social media and entertainment are of great interest while aboard long flights. Even today, it is not unusual to observe a majority of passengers using smart phones, ebooks, tablets and laptops on the typical flight. And where air-to-ground services are available, they are increasingly used.

Alcatel-Lucent forecasts wireless data growth (terrestrial and otherwise) of 30x by 2015 over that of 2010, approximately a factor of 100% growth year-over-year.<sup>1</sup> This is consistent with the historically higher growth that AT&T reported recently of 8000% over the previous 4 years (an 8000% increase).<sup>2</sup> While in-flight data usage is thought to be growing somewhat slower than this, as it becomes ubiquitous, it will likely experience a slightly delayed version of the terrestrial "boom." Consequently, Alcatel-Lucent supports Commission consideration of new spectrum blocks that could be cultivated for this emergent service.

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<sup>1</sup> See "Energy Efficient Networking: Avoiding a Future Energy Crunch," D Bishop, A. Hartman, D. Kilper, S. Korotky, D. Suvakovic, The 2010 Military Communications Conference, available at <http://202.194.20.8/proc/MILCOM2010/papers/p2390-bishop.pdf>; Kilper, D.C.; Atkinson, G.; Korotky, S. K.; Goyal, S.; Vetter, P.; Suvakovic, D.; Blume, O.; "Power Trends in Communication Networks," *Selected Topics in Quantum Electronics, IEEE Journal of*, vol.17, no.2, pp.275-284, March-April 2011.

<sup>2</sup> Applications of AT&T Inc. and Deutsche Telekom AG for Consent to Assign or Transfer Control of Licenses and Authorizations, Description of Transaction, Public Interest Showing and Related Demonstrations at 7, IB Docket No. 11-150 (filed Apr. 21, 2011).

Alcatel-Lucent further agrees with the Petition proposing a system and spectrum that can be uniquely optimized for air-to-ground service. Any spectrum that is allocated to either terrestrial or air-to-ground will inevitably be used only for terrestrial use. The value of terrestrial spectrum is much higher than for air-to-ground. This is seen in the relative sizes of the winning bids for Aircell's air-to-ground spectrum (\$30 million for 3 MHz and a nationwide license) compared with terrestrial operators bidding billions for nationwide licenses. The differences arise from the simple math that a nationwide terrestrial license serves the U.S. population of approximately 309 million people, while the number of people in the air at peak is roughly 400,000 to 500,000, or 0.16% of the terrestrial population. While these air travelers may have a greater willingness to pay, it is difficult for a prospective air-to-ground operator to justify paying a competitive price for spectrum in an auction with terrestrial operators.

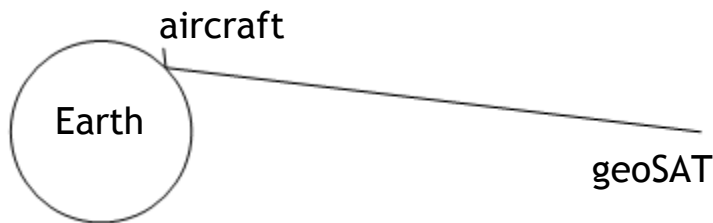
For these reasons, Alcatel-Lucent supports the allocation of additional spectrum to air-to-ground services and asserts that designing the spectrum use around the unique characteristics of air-to-ground operators is very appropriate.

### **III. ANY RULEMAKING PROCEEDING SHOULD INVOLVE A COMPREHENSIVE TECHNICAL REVIEW OF AIR-TO-GROUND SERVICE**

Alcatel-Lucent urges the Commission to use caution and consider Qualcomm's proposal as well as other proposals if it opens a rulemaking proceeding. In particular, Alcatel-Lucent highlights the following issues that should be reviewed more closely in any rulemaking proceeding to establish a next-generation air-to-ground communications service:

1. ***Any rulemaking proceeding should not prejudice the specific frequency and bandwidth.*** There are other spectrum license holders in discussions about how best to use otherwise stranded spectrum due to handset filter requirements that are too costly for handsets but that would not be a barrier to the cost of airborne terminal equipment. Unleashing stranded spectrum is preferable to sharing spectrum that is currently heavily used.

2. ***The optimal number of licensees should be subject to comment.*** The Qualcomm proposal calls for the auction of two licenses with the potential for a single bidder to obtain both (*see* page A-9). The Commission should not prejudge the appropriate number of licenses to be issued in advance of the rulemaking.
3. ***The number of ground stations should not be presumed.*** There are about 250,000 macrocells in North America serving a population of 308 million or 1,235 people per cell site. At this same ratio, we would expect that 500,000 air travelers would need 405 ground stations. The proposed air-to-ground system continues to use about 150 ground stations (*see* page A-2). This difference may be addressed in any number of ways, but the proposed use of 150 ground stations should not be presumed to be the best approach.
4. ***Qualcomm's interference assumptions should be reviewed.*** The calculations in section 3.3.1.2 regarding interference from the aircraft to the southern geoarch presume the aircraft antenna pattern is responsible for the connectivity of the aircraft to the satellite antennas (*see* page A-18). This does not consider specular and diffuse reflection from the ground. The emissions from the aircraft may reflect off of bodies of water and flat land in a way that may increase the coupling beyond that in the analysis. This is diagrammed below where the aircraft height above the earth is exaggerated for clarity. This mechanism of interference needs guidance from satellite measurements.



It is critical not to overlook potential harmful interference.

5. ***The amount of Doppler compensation required bears review.*** 14.5 GHz is a rather high frequency insofar as it will result in a Doppler frequency shift at aircraft speeds of about 11 kHz, a substantial fraction of, say, the 15 kHz subcarrier spacing of LTE subcarriers. All air-to-ground systems require some form of Doppler compensation, but this amount requires care in dealing with terminal acquisition ranges and the potential for rogue terminals with a wideband receiver that may generate similarly wideband emissions if its local frequency source is not stable.
6. ***Satellite information may not be provided in time to allow adjustments to forward link power.*** On page A-3, the Petition suggests protecting NGSO satellites by using the satellite ephemeris information to turn down the Forward Link transmit power for “the limited amount of time that the [ground station

(“GS”)], served aircraft and NGSO satellite are all in alignment.” This presumes that the satellite ephemeris is known well and in a timely way. Some NGSO satellites, however, may have in-flight maneuvers or course adjustments that are not measured in time for the power adjustment scheme.

7. ***GS Antenna Rolloff should be consistent with the handoff strategy.*** Page A-16 discusses a 6.4dB rolloff for 60 degrees of boresight for the GS antenna; however, the handoff strategy discussed in figure A.1 assumes little gain reduction for the GS located in the Southeast or Southwest cells so that handoffs can occur when aircraft are too close to the primary GS. The adopted system should be consistent about such stratagems. Also, the “Isoflux antenna” appears to be equivalent to the antenna type commonly used in RADAR where it is referred to as a CoSecant squared antenna.
8. ***Rise in uplink traffic should be taken into account.*** In 3.3.1.2 on page A-18, a 2MHz nominal uplink bandwidth is assumed. Yet Qualcomm has pointed out the enormous growth in uplink traffic from YouTube uploads.<sup>3</sup> Such growth should be considered in the air-to-ground context as well.
9. ***Certain assumptions regarding commercial flight patterns warrant further review.*** Roll angles and time spent in turns is assuming commercial flight characteristics (*see* page A-24). One may expect that general aviation may adopt this air interface as well, and their roll angles and time spent in turns will likely be higher, as general aviation flies around storms. These expected behaviors will raise the interference level more than the first blush analysis predicts.
10. ***The Petition understates the number of aircraft that will use the air-to-ground system.*** Qualcomm’s Petition presumes just 600 aircraft over CONUS (page 14) but this is likely too low. Already there are over 1000 aircraft equipped for air-to-ground services and more can be expected to adopt such systems in the future. There are about 5000 commercial passenger aircraft over the United States at the same time during a typical day. As demand grows, most of the 5000 aircraft may require air-to-ground systems.
11. ***The Commission should consider harmonizing its approach with international standards.*** A fundamental strategic concern is the market demand to globalize air-to-ground systems, whether for flights within the Americas or for use on other continents. Alcatel-Lucent is currently trialing an air-to-ground system in Europe based upon modifications to the industry standard 3GPP LTE air interface.<sup>4</sup> It

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<sup>3</sup> Petition for Rulemaking at 9 (“The YouTube service also is remarkable for it is one of the largest sources of data uploads. More than 48 hours - two full-day’s worth - of video is uploaded to the site every single minute, which is double the amount of content that was uploaded per minute last year”).

<sup>4</sup> *See* CEPT ECC (Electronic Communications Committee Project Team FM PT 48(11)-3- Rev 1), available at [http://cept.org/Documents/fm-48/1191/FM48\\_11\\_030rev1\\_Reduction\\_of\\_the\\_number\\_of\\_candidate\\_bands](http://cept.org/Documents/fm-48/1191/FM48_11_030rev1_Reduction_of_the_number_of_candidate_bands). This forum has been considering European frequencies for use with air-to-ground.

would be unfortunate if the U.S. were to adopt an air-to-ground system that is incompatible with the system adopted in Europe.

12. *New air-to-ground rules should be technology neutral.* The Commission should remain technically agnostic to the specific air interface to be used, and focus on the mitigation of interference among the various license holders.

#### IV. CONCLUSION

Alcatel-Lucent respectfully submits these comments in support of commencing a rulemaking proceeding. However, Alcatel-Lucent recommends that the Commission give due consideration to alternatives for the specifications of the system to be adopted, including the frequency bands, bandwidth and other characteristics discussed above.

Respectfully submitted,

Alcatel-Lucent

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